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INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY
(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference 2032825PC/or	FOR FURTHER ACTION See Form PCT/IPEA/416	
International application No. PCT/FI2005/000046	International filing date (day/month/year) 21-01-2005	Priority date (day/month/year) 23-01-2004
International Patent Classification (IPC) or national classification and IPC See Supplemental Box		
Applicant ABB Oy et al		

1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.
2. This REPORT consists of a total of 6 sheets, including this cover sheet.
3. This report is also accompanied by ANNEXES, comprising:
 - a. ☒ (sent to the applicant and to the International Bureau) a total of 2 sheets, as follows:
 - ☒ sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).
 - ☐ sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.
 - b. ☐ (sent to the International Bureau only) a total of (indicate type and number of electronic carrier(s)) _____, containing a sequence listing and/or tables related thereto, in electronic form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).

4. This report contains indications relating to the following items:

- | | | |
|-------------------------------------|--------------|---|
| <input checked="" type="checkbox"/> | Box No. I | Basis of the report |
| <input type="checkbox"/> | Box No. II | Priority |
| <input type="checkbox"/> | Box No. III | Non-establishment of opinion with regard to novelty, inventive step and industrial applicability |
| <input type="checkbox"/> | Box No. IV | Lack of unity of invention |
| <input checked="" type="checkbox"/> | Box No. V | Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement |
| <input type="checkbox"/> | Box No. VI | Certain documents cited |
| <input type="checkbox"/> | Box No. VII | Certain defects in the international application |
| <input type="checkbox"/> | Box No. VIII | Certain observations on the international application |

Date of submission of the demand 14-11-2005	Date of completion of this report 24-01-2006
Name and mailing address of the IPEA/SE Patent- och registreringsverket Box 5055 S-102 42 STOCKHOLM Facsimile No. +46 8 667 72 88	Authorized officer Ender Dag/MN Telephone No. +46 8 782 25 00

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International application No.

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Supplemental Box

In case the space in any of the preceding boxes is not sufficient.
Continuation of: Cover sheet

INTERNATIONAL PATENT CLASSIFICATION (IPC) :

G05B 13/02 (2006.01)

G06F 17/14 (2006.01)

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Box No. I Basis of the report

1. With regard to the **language**, this report is based on:

- ☐ the international application in the language in which it was filed
- ☐ a translation of the international application into _____,
which is the language of a translation furnished for the purposes of:
- ☐ international search (Rules 12.3(a) and 23.1(b))
- ☐ publication of the international application (Rule 12.4(a))
- ☐ international preliminary examination (Rules 55.2(a) and/or 55.3(a))

2. With regard to the **elements** of the international application, this report is based on (*replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report*):

- ☐ the international application as originally filed/furnished
- ☒ the description:
pages 1 - 16 _____ as originally filed/furnished
pages* _____ received by this Authority on _____
pages* _____ received by this Authority on _____
- ☒ the claims:
pages _____ as originally filed/furnished
pages* _____ as amended (together with any statement) under Article 19
pages* 17 - 18 received by this Authority on 2005-11-14
pages* _____ received by this Authority on _____
- ☒ the drawings:
pages 1 - 2 _____ as originally filed/furnished
pages* _____ received by this Authority on _____
pages* _____ received by this Authority on _____
- ☐ a sequence listing and/or any related table(s) – see Supplemental Box Relating to Sequence Listing.

3. ☐ The amendments have resulted in the cancellation of:

- ☐ the description, pages _____
- ☐ the claims, Nos. _____
- ☐ the drawings, sheets/figs _____
- ☐ the sequence listing (*specify*): _____
- ☐ any table(s) related to the sequence listing (*specify*): _____

4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).

- ☐ the description, pages _____
- ☐ the claims, Nos. _____
- ☐ the drawings, sheets/figs _____
- ☐ the sequence listing (*specify*): _____
- ☐ any table(s) related to the sequence listing (*specify*): _____

* If item 4 applies, some or all of those sheets may be marked "superseded."

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.

PCT/FI2005/000046

Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Claims	<u>1-12</u>	YES
	Claims	_____	NO
Inventive step (IS)	Claims	<u>1-12</u>	YES
	Claims	_____	NO
Industrial applicability (IA)	Claims	<u>1-12</u>	YES
	Claims	_____	NO

2. Citations and explanations (Rule 70.7)

Reference is made to the following documents:

D1: US 6006170 A
 D2: US 4156920 A
 D3: US 3634668 A
 D4: US 4715000 A

The applicant describes the problem of optimization the computing of parameters based on samples of received input data, which is to be controlled in an automatic control device of an electric motor. To prevent or limit damage of the control device from interruption requires fast, reliable and less number of variable algorithms to go through for handling the samples of input data. The intention of the applicant is to optimize the handle of the input data with discrete Fourier transform algorithm based on fixed number of sampled data. To fix the sampled data in relevant interval makes it possible to handle fewer amounts of data and efficiently calculate relevant data to be controlled.

Document D1 discloses a computer-based system and method for computing and processing a set of fast Fourier transforms based on a set of input sample current values for an electric motor. The steps for the computing comprises initializing, reading in set data, computing a set of Fourier transforms based on input data and generating a feature vector from a number of set data referred to a defined condition (see column 3, lines 23-45; claim 1).

Document D2 discloses a computer system architecture and

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Supplemental Box

In case the space in any of the preceding boxes is not sufficient.

Continuation of: BOX V

method for performing discrete Fourier transform on a set of sampled input signals. The plurality of input signals is selected to be product of a group of predetermined prime factors. The system architecture is adapted to optimize the number of calculations necessary to perform rapid and efficient calculation of the Fourier transform based on the set of sampled input signals. Initialization phases initiate all of the data to a defined condition of the system (see column 4, line 64 - column 8, line 39; abstract).

Document D3 discloses a signal processor apparatus for performing the discrete Fourier transform of samples of input signal. The output signal value information is related to the number of samples of the input signal (see column 1, line 6 - column 2, line 51; abstract).

Document D4 discloses a method and an apparatus to receive samples of input signal for performing a discrete Fourier analysis on these values. The sampled input signal is associated with a first and a second plurality of data to perform and provide two discrete Fourier analyses (see column 3, lines 5-55; abstract; figures 1-2).

The problem to be solved is to compute and optimize the control of input samples with a discrete Fourier transform algorithm. The calculations necessary for computing the parameter are optimized by appropriately by adjusting the sampling rate with the nominal frequency of the monitored device such that a predefined number of samples are provided per cycle. The number of samples is chosen such that operations based on fixed coefficients are possible. This improves the computing task by short response times with lesser computing. D1-D4 shows utilization of Fourier transform in different contexts. None of the indicated documents refer to control operations based on monitoring cyclic voltages/currents corresponding to the number of samples per cycle or fewer amount of data to be processed.

The problem to be solved in D1-D4 does not address the same problem to be solved in the claimed invention. D1-D4 describes alternative way of utilization of Fourier transform in different computer system architecture.

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Supplemental Box

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Continuation of: BOX V

The problem of the claimed invention is to reduce the calculations necessary by optimizing the computing task based by adjusting the input to a predefined number of samples per cycle, chosen such that the equations of discrete Fast Fourier Transformer (FFT) comprise several fixed coefficients. The FFT is optimized on the basis of these fixed coefficients and the optimized FFT is used to calculate the parameters. This improves the reduction of fewer amounts of data for computation with faster response time.

Hence, it is not obvious for a person skilled in the art to modify D1-D4 to solve the same problem as referred to in the claimed invention.

The invention according to claims 1-12 is novel, industrial applicable and is considered to involve an inventive step.

CLAIMS (AMENDED 11.11.05)

1. An automatic control device (1), comprising
input means (21, 24) for inputting samples comprising measured
values (7) of cyclic voltage and/or current with a defined nominal frequency;
5 computing means (21) for computing a parameter on the basis of
said samples, and for comparing the computed parameter to a predefined
condition;

initiating means (21, 23) for initiating a control function in response
to the parameter meeting the predefined condition; c h a r a c t e r i z e d by

10 said input means (21, 24) being arranged to input a predefined
number of samples per one cycle of the nominal frequency;

said computing means (21) being arranged to compute the parame-
ter with a discrete Fourier transform algorithm optimized on the basis of fixed
coefficients corresponding to said predefined number of samples per cycle of
15 the nominal frequency.

2. An automatic control device as claimed in claim 1, c h a r a c -
t e r i z e d in that said predefined number is a power of 2.

3. An automatic control device as claimed in claim 1 or 2, c h a r -
a c t e r i z e d in that said predefined number is 32.

20 4. An automatic control device as claimed in claim 1, 2 or 3,
c h a r a c t e r i z e d in that in said optimized Fourier transform algorithm cal-
culations involving coefficients fixed to zero have been eliminated.

5. An automatic control device as claimed in any one of claims 1 to
4, c h a r a c t e r i z e d in that in said optimized Fourier transform algorithm
25 multiplication by fixed coefficients 1 or -1 are avoided by use of signs.

6. An automatic control device as claimed in any one of claims 1 to
5, c h a r a c t e r i z e d in that in said optimized Fourier transform algorithm
two or more multiplications by a fixed coefficient have been combined into a
sum equation.

30 7. An automatic control device as claimed in any one of claims 1 to
6, c h a r a c t e r i z e d in that in said optimized Fourier transform algorithm
samples and coefficients are brought to integer form by multiplication by a
value that is fourteenth power or higher of two.

8. An automatic control device as claimed in any one of claims 1 to
35 7, c h a r a c t e r i z e d in that said computing means are arranged to com-

pute a parameter that is one of the following: root-mean-square current, power factor, (sign), distortion, earth fault current.

9. An automatic control device as claimed in any one of claims 1 to 8, characterized in that the automatic control device is an electric protection device and said control function comprises isolation of a second device (3) from the electric line (2).

10. An automatic control device as claimed in any one of claims 1 to 8, characterized in that the automatic control device is connected to a generator (40) feeding the electric line (42) and said control function comprises adjustment of the operation of said generator.

11. A method for automatic control of an electrically operated device, comprising

inputting samples comprising measured values of cyclic voltage and/or current with a defined nominal frequency;

computing a parameter on the basis of said samples;

comparing the computed parameter against a predefined condition;

initiating a control function in response to the parameter meeting the predefined condition;

characterized by

fixing the number of samples input per one cycle of the defined nominal frequency;

computing the parameter with a discrete Fourier transform algorithm optimized on the basis of fixed coefficients corresponding to said predefined number of samples per cycle of the defined nominal frequency.

12. A computer program product, executable in a computer, characterized in that execution of the computer program product in the computer causes the computer to carry out the steps of claim 11.